

# **MODEL H-255CU**

## **AUTOMATIC ANTENNA COUPLER**

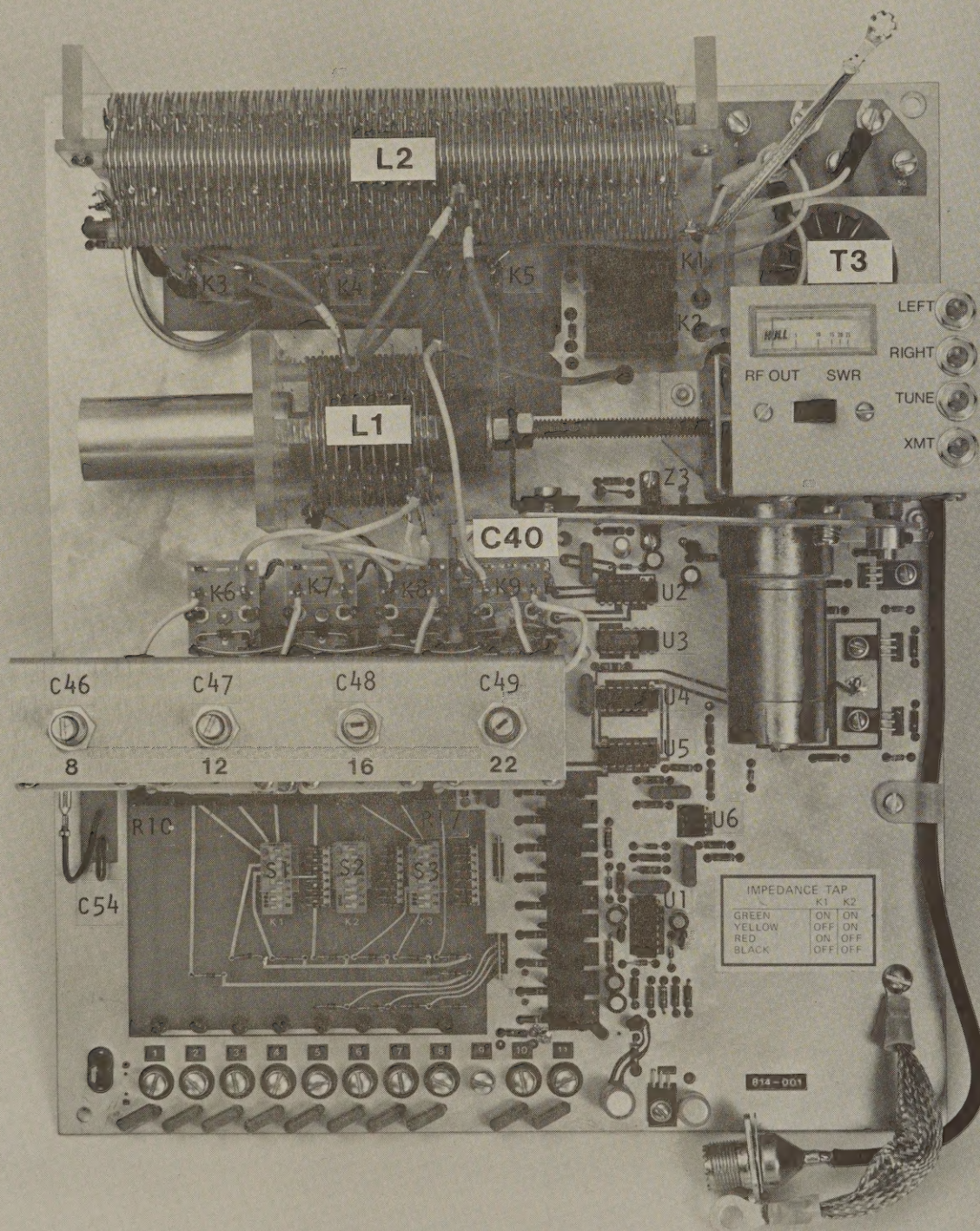
### **INSTRUCTION MANUAL**

- **INSTALLATION**
- **OPERATION**
- **MAINTENANCE**











# GENERAL INFORMATION

## DESCRIPTION

The Hull Model H-255CU Antenna Coupler is intended for use with the Hull Model 255 SSB Radiotelephone. Its purpose is to match the varying impedance of typical marine whip antennas to the 50 Ohm resistive impedance required by the radiotelephone. The coupler is capable of operation in all of the marine bands in the frequency range 2 - 22 MHz. Once the desired marine band has been selected, tuning to the exact frequency selected is automatic. In addition, the coupler adjusts the tuning automatically if the antenna impedance changes during any transmission as a result of moving objects, etc. The coupler is a complete single-package unit intended for either interior or exterior mounting. The package is weather-proof, but should not be considered waterproof. All necessary power for operating the coupler is obtained from the companion radiotelephone.

## EQUIPMENT FURNISHED

1. Hull Model H-255CU Antenna Coupler
2. Interconnecting 11-conductor control cable
3. Instruction manual

## SPECIFICATIONS

Number of channels — unlimited

Frequency range:

2 - 3 MHz  
4 MHz marine band  
6 MHz marine band  
8 MHz marine band  
12 MHz marine band  
16 MHz marine band  
22 MHz marine band

Power rating — 250 watts PEP max

Antennas — any length from 23' to 35'

Mechanical — Dimensions: 15½" H x 13½" W x 6½" D  
Weight: 14 lb.

# INSTALLATION

## GENERAL

Installation of the Model H-255CU coupler consists of pre-programming the unit to suit the antenna/ground system of the vessel, installing into the chosen location, and connecting the coupler to the radiotelephone. Programming procedures, interconnections, and information on suitable antenna systems are given in this section.

## PROGRAMMING

The coupler, as received from the factory, is properly programmed and tuned for use with a 23-foot unloaded whip antenna with a short lead-in and a good ground. Should the unit be used with some other length, it is not necessary to make any changes to the program matrix; the various coil taps will need relocating, and this must be done after installation has been completed.

## INSTALLATION

The coupler should be located close to the antenna base and as near as possible to the ground system. Mounting may be either vertical or horizontal. When planning the mounting position, remember that access to the inside of the coupler must be had to tune and adjust the unit. If the unit is mounted in a location exposed to the weather, a small (3/16" dia.) weep hole should be drilled in the cabinet at the lowest point. This allows water that collects as a result of condensation to drain from the cabinet.

Connection to the ground system must be short and direct. Use 2-inch wide copper strap, if possible. Otherwise, use several parallel runs of heavy wire. A discussion of suitable ground systems is given later in this section.

If the antenna lead-in is passed through a bulkhead, use a good quality glass feed-through insulator. The lead-in wire must be well insulated, such as GTO, since voltages at this point are quite high. If the lead-in is more than a few feet in length, the factory tuning will be found to be off.

Connections to the radiotelephone are made via the 11-conductor cable supplied and a suitable length of RG-8/U coaxial cable with a UHF male connector at each end. The length of both cables is not critical, and can be made as long as convenient.

Color coding of the 11-conductor cable is as follows:

- |    |              |
|----|--------------|
| 1  | BLACK        |
| 2  | RED          |
| 3  | ORANGE       |
| 4  | GREEN        |
| 5  | BLUE         |
| 6  | WHITE        |
| 7  | BLACK/WHITE  |
| 8  | BLACK/RED    |
| 9  | BLACK/ORANGE |
| 10 | BLACK/GREEN  |
| 11 | BLACK/BLUE   |

The control cable is routed through the stuffing gland at the cabinet bottom and connections are then made to the terminals at the bottom of the chassis. The coaxial cable connects to the female fitting at the cabinet bottom. The ground strap connects to the bolt at the cabinet bottom and the lead-in wire from the antenna connects to the large insulated terminal at the cabinet top.

## ANTENNA

As specified, the antenna may be any length from 23' to 35'. The antenna may be mounted as convenient, except that locations near surrounding metal objects such as rigging, stacks or outriggers, other antennas, etc., should be avoided.



## GROUND SYSTEM

If the vessel is of metal construction, run the grounding strap to the nearest metal member. Connection must be electrically secure. Use a stainless bolt that has been brazed or silver-soldered to the metal member, if possible. If the boat is of wood or fiberglass construction, proper grounding becomes more difficult. For the lower frequencies, 2 through 4 MHz, a copper strap to the engine block and other large metal objects will usually suffice. For the higher frequencies, a ground plane near the antenna base must be established. This can consist of large metal objects at deck level, copper screening, etc.

Quite often, an effective ground for the higher frequencies can be established by a resonant counterpoise for each band. The lengths required are:

- 6 MHz — 38'
- 8 MHz — 28'
- 12 MHz — 19'
- 16 MHz — 14'
- 22 MHz — 10½'

These counterpoises can consist of #16 wires, moderately well insulated, with one end of all the wires connected to the ground post of the coupler. The wires should be laid out horizontally under the deck in a straight line as much as possible. The various wires can be bunched together. Make certain that the wire ends do not touch any metal objects.





# TUNING PROCEDURES

## GENERAL DESCRIPTION

The Model H-255CU Antenna Coupler consists of a slug-tuned coil (L1), an auxiliary coil (L2), an impedance-matching autoformer (T3) and a series of variable capacitors that combine with L1 to form an "L" network on the higher-frequency bands. The coupler also includes a reversible motor that positions the tuning slug of L1, and appropriate motor-control circuitry. A tuning meter is included to enable the technician to monitor relative antenna current and standing-wave ratio existing on the coaxial line leading back to the transmitter.

## DESCRIPTION OF OPERATION

Automatic tuning of the coupler for any given frequency is a two-step process. In the first step, the tuning slug of L1 is PRESET to a position controlled by a "memory" potentiometer. A separate memory pot is provided for each of the eight tuning ranges of the coupler. After the slug has been PRESET, control of the tuning motor is switched to a phase discriminator which causes the motor to drive the tuning slug to the position that produces resonance of the antenna circuit. Each step of the tuning process is switched on by a timing circuit. The timer allows as long as 10 seconds for the motor to seek the correct position. When the first step has been completed, a speed-up network causes the first timer to "time-out" quickly and the second step is immediately started. Again, once the motor has found the correct position, the speed-up network quickly times out the second timer and the tuning process is completed. Typically, the two steps are completed in a total time of about 4 seconds.

## ADJUSTABLE COMPONENTS

The various adjustable components that combine to tune the system at the eight tuning ranges are:

L1	This slug-tuned inductor is provided with 5 taps, labelled 3 through 7. Tap 3 adjusts the inductance range for 4 MHz and 6 MHz. Taps 4 through 7 set the inductance range for the marine bands 8 through 22 MHz respectively.
L2	This inductor is supplied with two taps, labelled 1 and 2. Tap 1 adjusts for the range 2.0 — 2.4 MHz; tap 2 adjusts for the range 2.4 — 3.0 MHz. L2 is shorted out and not used on any of the higher bands.
T3	This impedance autoformer matches the impedance of the resonated antenna circuit to the 50 ohms required by the transmitter. Four color-coded taps are provided which select from the six outputs of T3. These taps, in turn, are selected by relays K1 and K2.
S1, S2	These switches are used to control K1 and K2 in assigning jumpers for impedance matching on the various bands. Normally, good matching can be obtained with the following combination:

K1	K2	JUMPER	BAND
ON	ON	GREEN	2.0 - 2.4 & 2.4 - 3.0 MHz
OFF	ON	YELLOW	4 & 6 MHz
ON	OFF	RED	8 MHz
OFF	OFF	BLACK	12, 16, & 22 MHz

S3	This switch is used to control K3 when series capacitance is required in the antenna circuit.
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S3 ON adds series capacitance. S3 OFF eliminates series capacitance. Normally, S3 is ON when the 6 MHz band is selected.



## ADJUSTABLE COMPONENTS Continued

- C46 - C49 These variable capacitors are provided to achieve matching in the 8 through 22 MHz bands where an "L" section network is required. The capacitors, in conjunction with the taps on L1, are adjusted for the best match.
- C54 This capacitor is used only at 8 MHz and may be required to increase the maximum capacity of C46. The capacitor is paralleled with C46 by means of a built-in jumper.
- C40 This compression-type capacitor is used only at 22 MHz and is required to offset the leakage reactance of T3, which becomes large at this high frequency. The capacitor is adjusted for lowest SWR in conjunction with C49 and Tap 7 on L1.
- R10 - R17 These eight potentiometers are the "memory" pots, one for each tuning range, that PRESET the tuning slug in the first step of the tuning process. They are factory set and should not normally be changed in the field. It is important that the PRESET position of the tuning slug be to the **left** of the final tuning slug position.
- SWITCHES Four push-button switches are provided to simplify tuning. They are:
- |       |   |
|-------|---|
| RIGHT | Moves the tuning slug to the right                        |
| LEFT  | Moves the tuning slug to the left                         |
| TUNE  | Moves the tuning slug to the PRESET position              |
| XMT   | Turns the transmitter on and inserts a low-level carrier. |

NOTE: Pushing the TUNE and XMT buttons together enables tuning the coupler with the slug locked in the PRESET position.

## TUNING TO THE MODEL 255 RADIOTELEPHONE

Following is a step-by-step procedure for tuning the coupler to the Model 255 Radiotelephone. It is assumed that all leads and cables have been correctly installed and the system is ready to operate.

- STEP 1 Select 002 (2003 KHz) on the keyboard. The tuning slug will first move to the PRESET position and then hunt until the 2nd timer times out. Now, with the TUNE and XMT buttons pressed and the meter switch in RF OUT position, find the spot on L2 with the #1 tap that produces the highest meter reading. With the tap fixed at this spot, see that the meter reads less than 5 with the meter switch in SWR position. If the reading is higher than 5, try another tap on T3 with the GREEN jumper. After a satisfactory meter reading has been obtained, test the tuning by moving the slug slightly to the right with the RIGHT button and then press the XMT button. The slug should drive to the position giving minimum SWR reading and highest RF OUT reading.
- STEP 2 Select 030 (2390 KHz). The slug should first drive to PRESET position and then to the point giving highest RF OUT and lowest SWR. This completes adjustments for the range 2.0 - 2.4 MHz.
- STEP 3 Repeat STEP 1, using 031 (2406 KHz) and the #2 tap on L2.
- STEP 4 Repeat STEP 2, using 043 (2830 KHz). If the SWR is noticeably lower or higher than that obtained in STEP 1, select an impedance tap with the GREEN jumper that gives about equal SWR readings on STEP 1 and STEP 4. This completes adjustments for the range 2.4 - 3.0 MHz.
- STEP 5 Select 059 (4063 KHz). After the slug has stopped hunting, press the TUNE and XMT buttons and find the spot on L1 with the #3 tap that produces the highest RF OUT indication on the meter. Then select the impedance tap with the



## TUNING TO THE MODEL 255 Continued

YELLOW jumper that gives the lowest SWR reading. Next press only the XMT button and see that the slug drives to the position giving the lowest SWR reading after having been displaced slightly with the LEFT and RIGHT buttons.

**STEP 6** Select 096 (6521 KHz). See that the slug drives to the position giving the highest RF OUT indication. With the XMT button pressed, note the SWR reading and compare with the reading obtained in STEP 5. If one is considerably higher than the other, a compromise impedance tap with the YELLOW jumper may improve the overall match. This completes adjustments for the 4 MHz and 6 MHz bands.

**STEP 7** Select 137 (8291 KHz). After the slug has finished hunting, press the TUNE and XMT buttons and, using the #4 tap on L1 and the 8 MHz capacitor (C46), find the combination giving highest RF OUT and lowest SWR indications (if C46 is at maximum capacity, C54 must be placed in parallel, by use of the built-in jumper, to increase the maximum capacity of C46). It may be necessary to try several impedance taps with the RED jumper to obtain the best match. After the adjustments are completed, move the slug slightly with the RIGHT and LEFT buttons and see that the slug returns to the optimum tuning position when the XMT button is pressed. This completes tuning for the 8 MHz band.

**STEP 8** Select 171 (12,429 KHz). Repeat STEP 7, using the #5 tap on L1, the 12 MHz capacitor (C47), and the BLACK jumper.

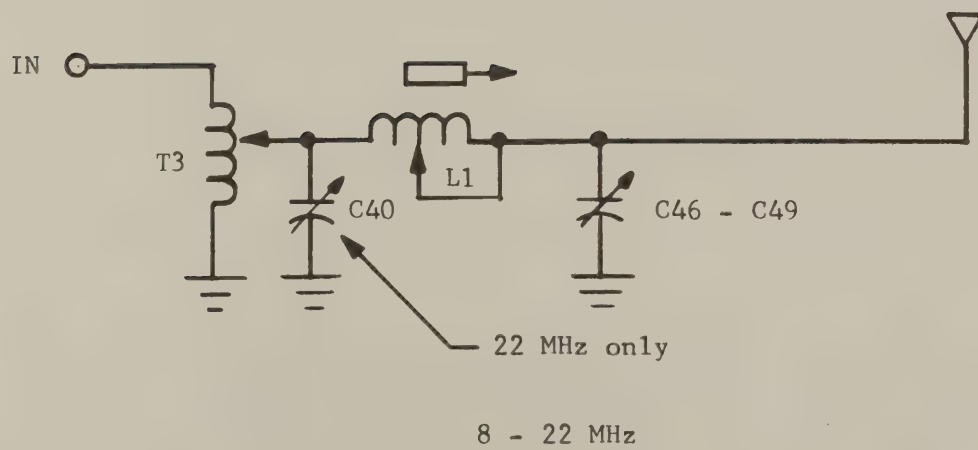
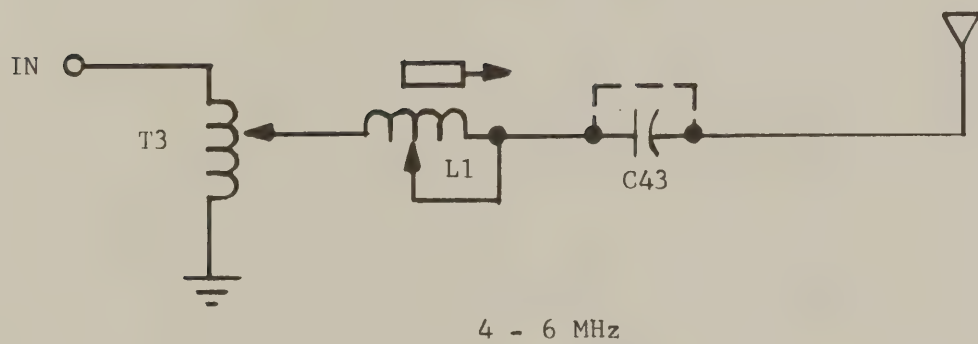
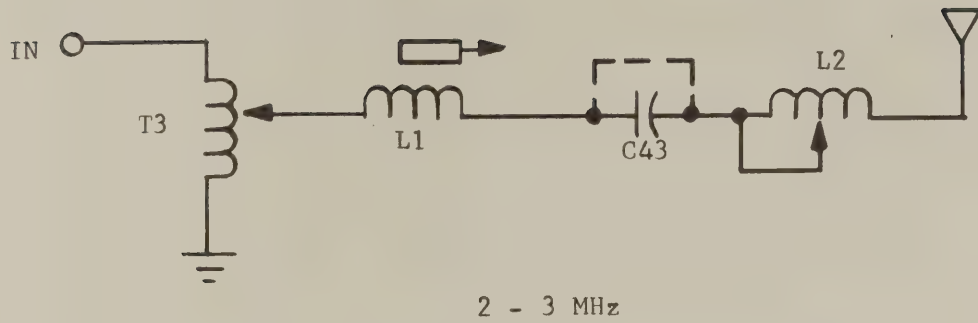
**STEP 9** Select 224 (16,587 KHz). Repeat STEP 7, using the #6 tap on L1 and the 16 MHz capacitor (C48). The BLACK jumper should not be moved from the position selected in STEP 8. The automatic tuning action is not used on this band and the slug will not return to the correct position of deflected by the RIGHT or LEFT buttons. Correct tuning is obtained with the slug in the PRESET position.

**STEP 10** Select 240 (22,124 KHz). Repeat STEP 7, using the #7 tap on L1, the 22 MHz capacitor (C49), and the compression capacitor C40. The automatic tuning action is not used on this band and correct tuning is obtained with the slug in the PRESET position. This completes tuning the 12, 16, and 22 MHz bands.

**NOTE:** If satisfactory matching is not obtained with the same impedance tap in steps 8, 9, and 10, it will be necessary to assign new jumpers to the various bands. This is done by altering the switch settings controlling K1 and K2.

This completes tuning of the coupler. Test performance on all the frequencies used in Steps 1 through 10 and then install the coupler top cover.

## TUNER CONFIGURATIONS





# THEORY OF OPERATION

## GENERAL

The Hull H-255CU Automatic Antenna Coupler can be divided into four basic functional groups. These are: RF Circuits, Pre-set Function, Automatic Tune Function, and Motor Control. A detailed operational description of each group is given below.

## RF CIRCUITS

The basic coupler RF circuit for the various frequency bands is shown in figure 4-1. In the 2 - 3 MHz range, L1 and L2 combine to provide the series inductance required to resonate a normal marine antenna to these frequencies. Should the antenna be physically longer than one-quarter wavelength in this frequency range, a series capacitor, C43, may be switched into the circuit by actuating relay K3.

In the range 4 - 6 MHz, L2 is removed from the circuit and all tuning is done with L1. Again, C43 may be required, depending upon antenna length.

For frequencies in the range 8 - 22 MHz, L1 is combined with an output capacitor (C46 - C49) to form an "L" network. For 22 MHz frequencies, it is necessary to add an input capacitor, C40, to tune out the reactance inherent in T3.

## PRESET FUNCTION

The preset function is initiated when a channel is selected by the radiotelephone operator. Assume that a channel at 2182 KHz has been selected. A high voltage (about 7.0 volts) appears on Terminal 1 and CR10 lights. The current through CR10 causes a voltage drop across R19, and this positive-going voltage transition is coupled through C21 and C22 to an input of U1D. U1D and U1C are connected as a one-shot multivibrator and the incoming voltage transition triggers a cycle of one-shot operation. The circuit constants are such that a cycle will continue for about ten seconds. During the cycle, a high appearing on pin 10 of U1C is coupled through CR20 and R26 to the base of Q21. This stage, in turn, supplies high base current to Q22, which causes the push-to-talk relay at the radiotelephone to actuate, thus turning on the transmitter. This circuit also automatically inserts a measured amount of carrier into the transmitter signal.

The high at pin 10 of U1C also is applied through the R29 to the control electrodes of U5B and U5D. This device is a 4-section switch which conducts when the control electrode is high and becomes an open circuit when the electrode is low. The incoming high from U1C is also passed through inverter U2b to the remaining electrodes of U5. In this configuration, U5 functions as a DPDT switch and selects the two inputs appearing on pins 1 and 8. These two inputs are passed through to R48 and R49.

The input on pin 1 of U5 is a DC voltage produced from the 7-volt input on Terminal 1. The voltage is passed through CR33 and adjusted in amplitude by R10. The other input to U5, appearing on pin 8, is derived from R46, a potentiometer mechanically coupled to the motor. Thus, two d-c voltages are passed through U5 to the two inputs of U6B. As will be explained in the Motor Control portion of this section, the motor operates until such time as the two inputs to U6B are equal in amplitude.

## AUTOMATIC TUNE FUNCTION

When one-shot U1C and U1D times out at the end of the PRESET FUNCTION, a positive-going transition appearing on pin 11 of U1D is coupled through C24 to an input of U1B and U1A, also connected as a one-shot. The transition triggers a ten-second operational cycle of U1A/B and a high appearing on pin 3 is coupled through CR21 to maintain the push-to-talk function in the transmitter.

The inputs to U5 are now switched and two voltages from phase-discriminator CR22 and CR23 are now passed through U4 and U5 to the inputs of U6B. If the two voltages from the discriminator are different in amplitude, the motor will operate and drive the slug of L1 until the coupler is correctly matched to the antenna. At this time, the phase-discriminator voltages become equal and the motor stops.

## **AUTOMATIC TUNE FUNCTION Continued**

If, during the AUTOMATIC TUNE FUNCTION, the motor drives the slug of L1 to the end of its travel before correct tuning has been arrived at, a blade travelling through the optical slot of Z3 senses the end of travel and Z3 produces a negative-going output. This output is inverted by U2D (which also prevents operation of the circuit in the PRESET FUNCTION). U2D output is applied to a flip-flop U3. The two outputs of U3 (pins 1 and 2) control the electrodes of U4, which acts as a double-pole reversing switch. The total function of this circuit is to reverse the two phase-discriminator output voltages whenever the tuning slug reaches the end of its travel. This causes the motor to reverse and search for correct tuning in the opposite direction. Note that the circuit operates only in the AUTOMATIC TUNE mode.

## **MOTOR CONTROL**

It has been noted above that the two input voltages to operational amplifier U6B control the motor operation. When the two voltages are equal, output from the amplifier is essentially half the input line voltage. This potential is passed through low-impedance driver U6A and applied through Zener diodes to the bases of Q25 and Q27. When the output of U6A is centered, the Zener diodes prevent conduction to both bases and Q25 and Q27 appear as open circuits. Since base bias to Q26 and Q28 depends on conduction of either Q25 or Q27, both Q26 and Q28 show as open circuits. In this state, the motor receives no driving current.

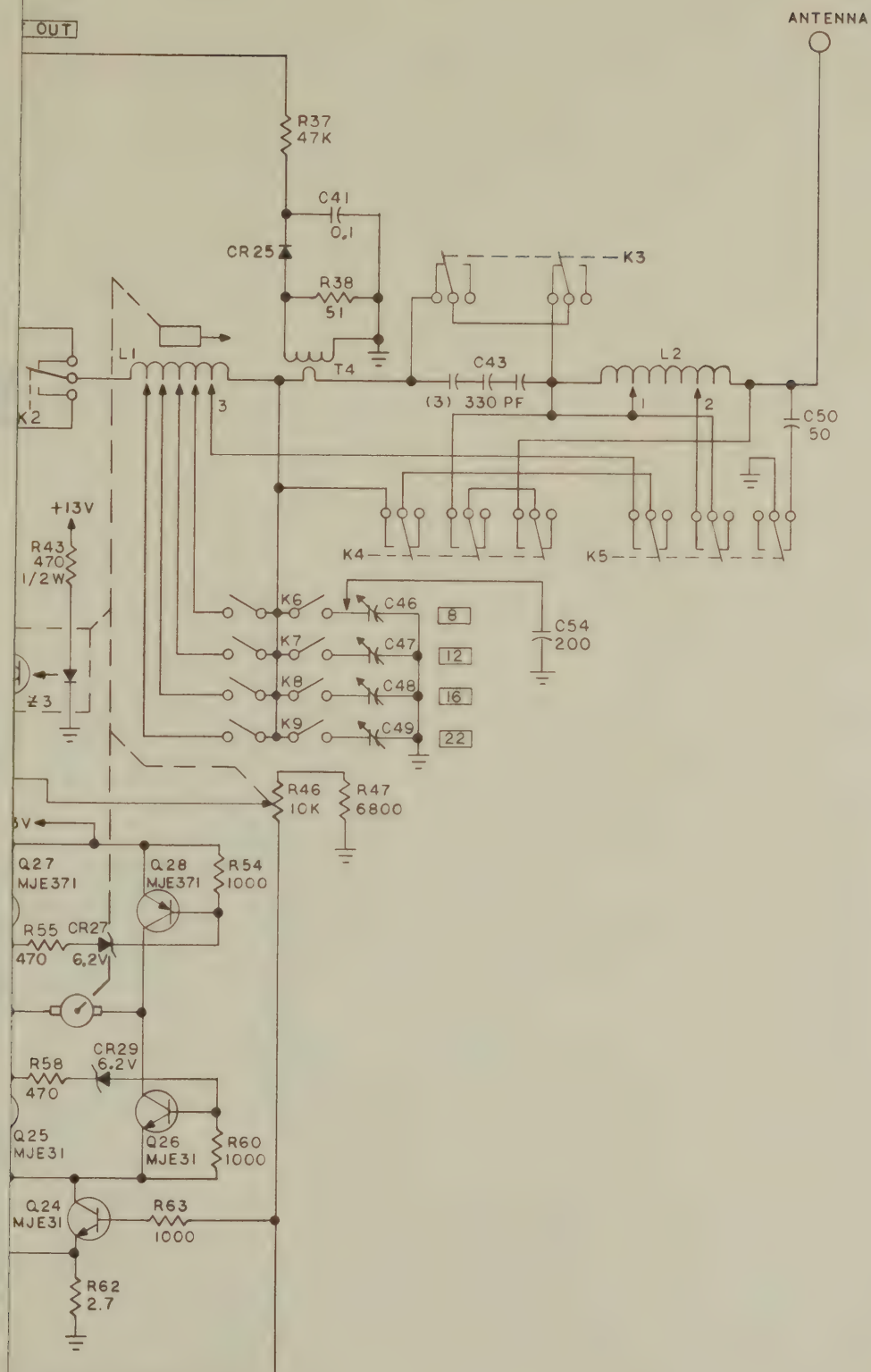
Assume now that the two inputs to U6B become unequal. Output from the amplifier swings either toward ground or +13 volts. If the swing is toward ground, the output from follower U6A is also toward ground. This causes conduction through Zener diode CR26 and Q27 becomes biased on. Its collector voltage rises toward +13 volts, and this voltage rise passes through R58 and CR29 to the base of Q26. The collector of Q26 is pulled toward ground and, if Q24 is conducting, the motor operates.

If the difference in voltage inputs to U6B is opposite in polarity, a similar action is created to drive the motor in the opposite direction. Motor operation depends on the conduction of Q24, and this transistor conducts only when a channel has been selected, since base bias is received through R63 from the LED indicators.

A speed-up circuit is created by the voltage drop across R62 in the ground return leg of the motor control array. When the motor is operating, voltage drop across this resistor is enough to bias Q23 to the on state, and its collector voltage is low. When the motor stops, Q23 becomes cut off and its collector voltage rises to +13 volts. This rise is passed through R65 and two diodes, CR18 and CR19, to the one-shots U1. The effect is to greatly shorten the time-on cycle of the one-shot, thus shortening the overall time required for the coupler to adjust to the selected channel.

Automatic tuning of the coupler to channels in the 16 and 22 MHz range is not necessary or desired. Diodes CR30 and CR31 in the control circuits of K8 and K9 conduct when a channel in this range has been selected. This conduction is inverted by U2C and coupled through CR32 to the PRESET FUNCTION line. This places the system in the PRESET mode and the slug position is held to the position determined by memory pots R16 or R17.





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## **AUTOMATIC TUNE FUNCTION Continued**

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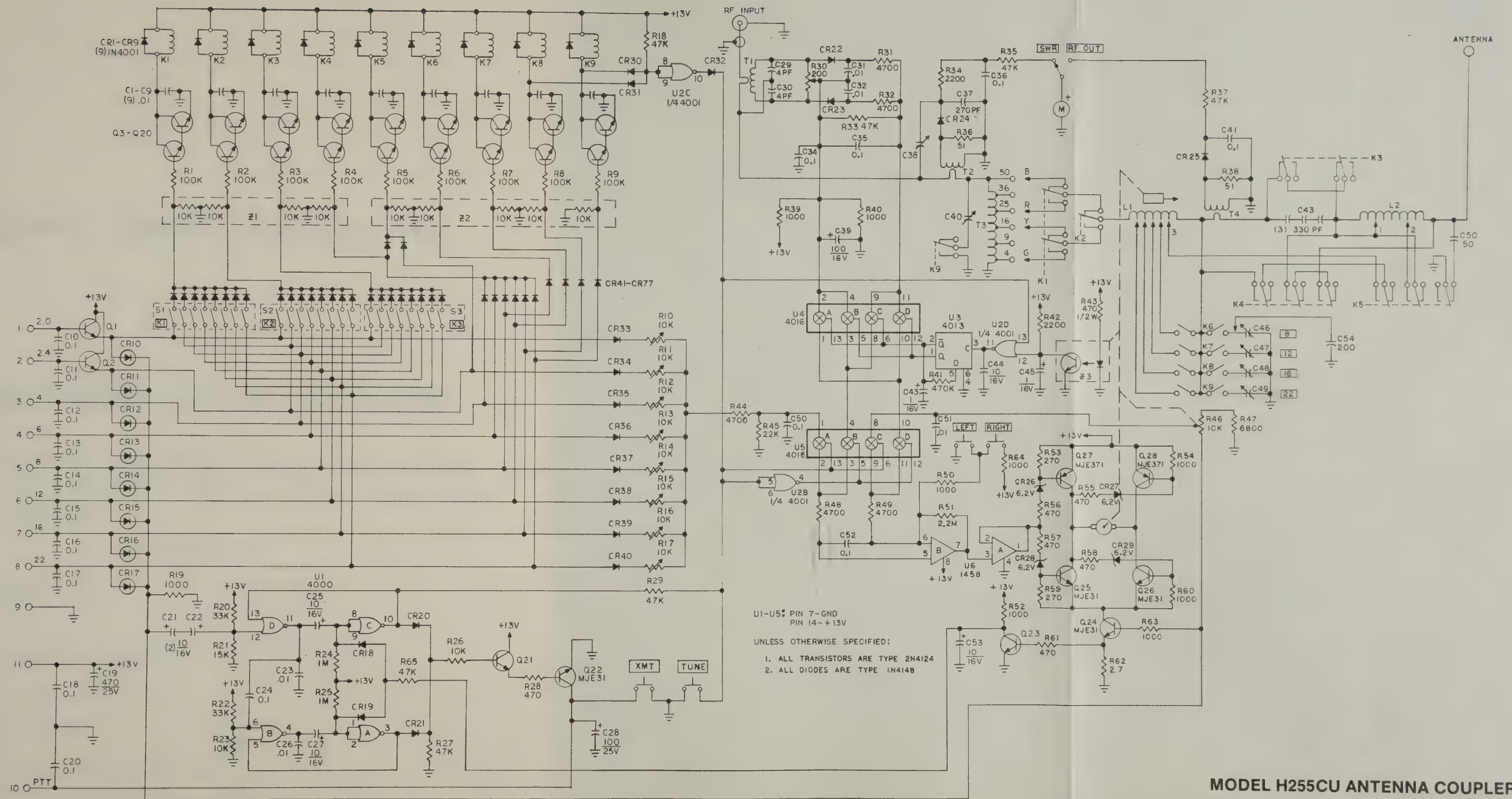
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MODEL H255CU ANTENNA COUPLER





# Regency Land Mobile, Inc.

## CUSTOMER QUESTIONNAIRE

In order for Regency Land Mobile, Inc. to provide you with accurate and informative manuals, please answer the following questions:

*(Tear Along Perforation)*

### DIAGRAMS AND ILLUSTRATIONS

1. ☐ Are accurate and easy to follow
2. ☐ Contain minor errors
3. ☐ Contain major errors
4. ☐ Are difficult to follow

If you have checked any box except 1, please tell us what diagrams, or portions thereof, were at fault, or enter other comments.

\_\_\_\_\_  
\_\_\_\_\_

### TEXT

1. ☐ Easy to follow - helps to service equipment
2. ☐ Would like more information on

 \_\_\_\_\_  
\_\_\_\_\_

3. ☐ Some instruction sections are too long or superfluous, such as

\_\_\_\_\_  
\_\_\_\_\_

### 4. Other comments

\_\_\_\_\_  
\_\_\_\_\_

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1. ☐ Are complete and accurate
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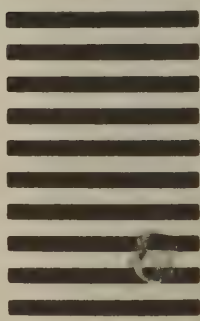
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## PROBLEM 5 - NO TRANSMIT POWER (Continued)

Keying the radio and measuring total current will give an indication of where the trouble in the PA might be found.

The following suggests possible problem areas for several current ranges (assuming zero output power).

<u>Current</u>	<u>Possible Problem Area</u>
8A or more	Q303 output circuit or T-R switch circuit
3-5A	Q301 and Q302 probably OK - possible bad Q303 or its input matching circuit
1-3A	Q301 circuit probably OK - possible bad Q302 or its input circuit
1A or less	Possible bad Q301 or input matching circuit









# 2 YEAR LIMITED WARRANTY

(EFFECTIVE ON PRODUCTS PURCHASED AFTER JULY 1, 1984)

## LIMITED WARRANTY

1. Regency Land Mobile, Inc. (including its parent and affiliate companies) (hereafter collectively referred to as "Regency") warrants, to the original purchaser only, its products to be free of defects in material and workmanship for a period of two (2) years from the date of purchase as shown on the original purchaser's sales receipt or other proof of purchase; provided, however, that the warranty period for the following accessories is one year from the date of purchase: rechargeable batteries, tone reeds, and coiled cords. For the first 90 days of the warranty period labor to perform warranty service will be provided without charge. Thereafter, purchaser must pay for any labor at the prevailing rates of the Authorized Warranty Repair Center or Regency. Parts necessary to provide warranty service will be provided at no charge for the entire warranty period. In the event of a defect during the warranty period, Regency shall, at its option, repair or replace the defective product or refund the purchase price of the product and such action shall constitute the purchaser's exclusive remedy under this warranty.

2. To obtain warranty service, the defective product must be delivered to the dealer of original purchase accompanied by the sales receipt or other proof of purchase.

3. Any part that is repaired or replaced under this warranty will, itself, be warranted only for the remainder of the warranty period of the original product under warranty.

4. The warranty does not apply to any product subject to misuse, neglect, accident, improper installation, unauthorized modification, or use in violation of Regency's instructions.

5. This warranty is given in lieu of all other warranties, whether expressed, implied, or statutory. ALL OTHER WARRANTIES (WHETHER EXPRESSED, IMPLIED OR STATUTORY), INCLUDING, WITHOUT LIMITATION, WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, ARE SPECIFICALLY EXCLUDED.

6. In no event shall Regency be liable for lost profits or for any incidental, consequential, special, indirect, punitive or exemplary damages. Nor shall Regency be liable for any transportation, removal, reinstallation or other similar costs incurred in connection with this warranty, all of which costs are to be paid by the purchaser.

7. Equipment and accessory items which are neither manufactured by Regency nor listed in paragraph 1 above are excluded from this warranty.

8. This warranty applies only within the United States.

9. This written warranty constitutes the final, complete and exclusive statement of warranty terms and no person is authorized to make any other warranties or representations on behalf of Regency.

CHANGES: Regency reserves the right to modify or change the equipment in whole or in part at any time prior to delivery in order to include refinements deemed appropriate by Regency, but without incurring any liability to modify or change any equipment previously delivered, or to supply new equipment in accordance with earlier specifications.

## **Regency Land Mobile Inc.**

A Subsidiary of Regency Electronics Inc.

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